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GB 2143395 A GB 1278929 A GB 1070176 A
US 4642017 A

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(54) Controlling movement of articles in a manufacturing installation

(57) Code means are assigned to article processing stations, such as a casting mould C and a subsequent station B (eg. a rolling mill) in a steel mill, and to article storage regions P1, P2, P3, P4. The code means may be in the form of transponders T inset into the floor at the various stations and regions. To move an article within the installation, a CPU transmits the codes of the article pickup and destination positions to an article conveying vehicle V. The vehicle V then moves to the pickup point, picks up the required article after checking for code match with the pickup point transponder T, transports the article to the destination and deposits the article after checking for a code match with the destination transponder T. Signal communications may be by radio waves or by optical, laser, or inductive coupling means.

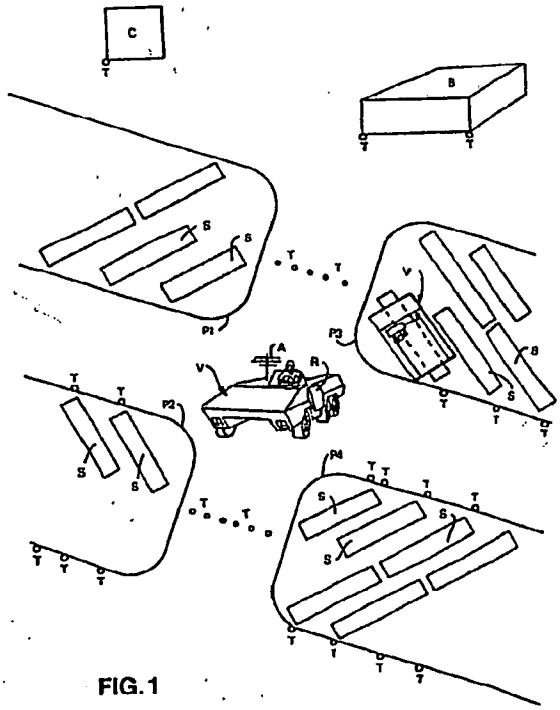

FIG.1

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At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

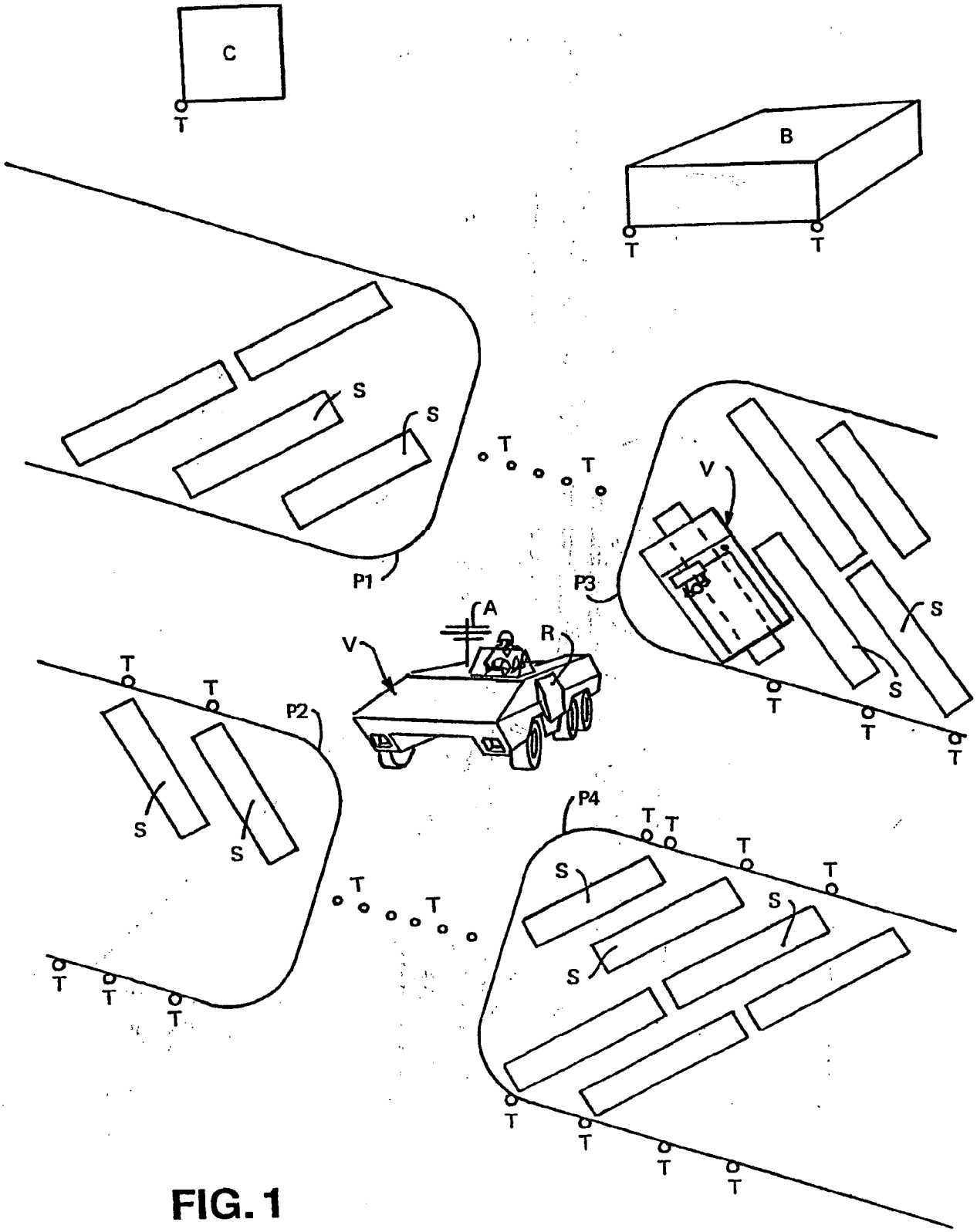

FIG. 1

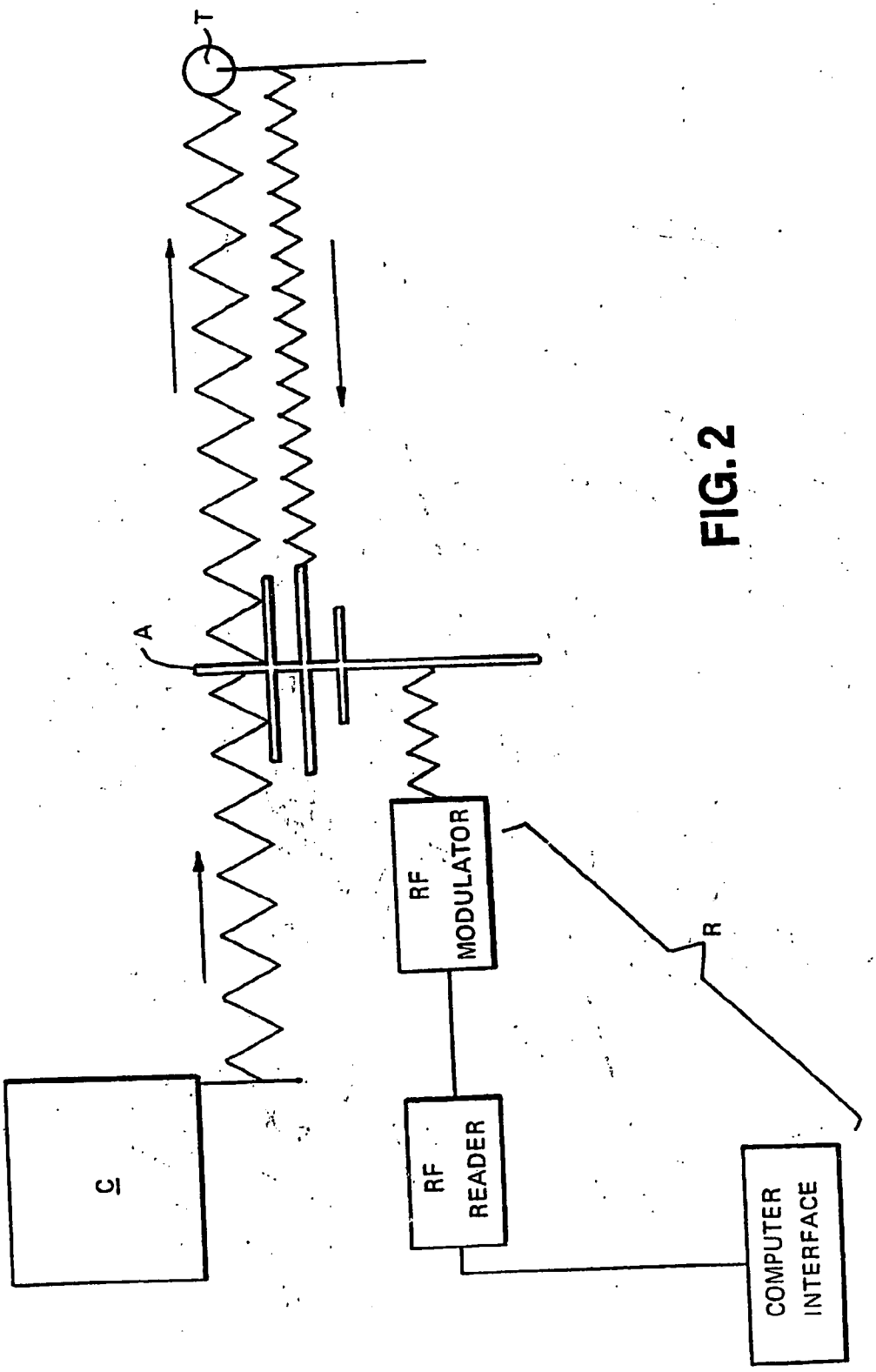

FIG.2

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- providing code reading means on the vehicle, identifying each batch to be moved by the code of its location and that of its destination, and causing the code reading means of the vehicle to confirm the present location code and the code of the destination station before removing the batch and confirming the destination code before depositing the transported batch.

In a preferred feature, the installation includes a CPU having a database which stores the identities of all the slabs by their positions in and around the steel mill. It has an input facility for updating and modifying data and can provide output to produce reports and to monitor progress. (It also has a security system to allow access only to those who require it). This package can be integrated with the caster and rolling mill computers so that the database can receive instructions and confirm execution automatically, without human input.

Preferably, the code reading means includes an antenna, a radio frequency reader and a radio frequency modulator, and the code means comprises a transponder whereby the radio frequency reader emits a signal via the antenna which activates the transponder, which in turn emits a radio signal unique to a particular position within the facility. A transponder is located next to each slab pile area to provide a means to identify that pile. Transponders are also installed on the roads and at different areas in the stockyard to enable tracking and define regions within the stockyard. The transponders may be installed underground to prevent damage either by vehicles or slabs.

Preferably the vehicles are robust, highly flexible rubber tyred machines which are not constrained by tracks such as overhead cranes, electric cables or railway. Each vehicle preferably carries a computer interface, an antenna, a radio frequency reader and a radio frequency modulator. The computer interface may communicate with the CPU holding the database via a radio link or the like.

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In operation the CPU will receive instructions from e.g. a casting computer by radio waves which are received by a radio frequency reader. The instructions will specify which slabs should be collected by a vehicle and where they are to be taken for storage or subsequent processing. The CPU will calculate the optimum storage site or position for these slabs, storing the information in the appropriate database. The CPU will transmit a radio signal to the computer interface of one vehicle to inform the operator that the slabs should be taken to the calculated optimum storage site. The radio signal will be received by the antenna on the vehicle, then modulated by the radio frequency modulator to be displayed on the computer interface. When the vehicle passes over the first slab pile transponder upon collecting the slabs, the radio frequency reader on the vehicle will emit a radio signal via the antenna to the transponder which will emit a further radio signal unique to its position within the factory. The signal will be modulated by the radio frequency modulator and a comparison of the two signals will be made to verify that the pile is correct. The verification will be displayed by the computer interface within the vehicle. If the two radio signals do not coincide, the computer interface will display that an error has been made, and will automatically update the CPU so that although an incorrect pile has been picked up, the positions of the slabs in each pile are still known. It is possible to override this or any automatic feature of the CPU and this would be flagged in a report printed at the end of every shift.

The vehicle driver than takes the slabs to the assigned station. When the vehicle passes over the transponder for that station, the radio frequency reader emits a radio signal via the antenna to the transponder, which will emit a further signal corresponding to its position within the factory. Confirmation that this is the correct position will be displayed on the computer interface, and if it is not the correct position the operator will be informed and the CPU updated automatically. In this way every slab may be tracked no matter what an operator does. The electronic

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verification by the transponders maintains the integrity of the system whilst the immediate updating ensures that the CPU can be interrogated at any time for information concerning a given slab.

The invention has the following advantages:

- reducing steel mill inventory. With total slab tracking no slabs will be lost which in turn leads to more efficient casting because many times an entire cast has to be made again even if only one slab is lost;

- reducing vehicle movements. This will reduce lead times as slabs are placed in the nearest available position to their next process. This will also increase vehicle efficiency as the CPU identifies and recommends the batch closest to the vehicle as the next batch of articles to transport. This will also reduce the risk of human error, from either caster, rolling mill or other employees.

- reducing human input and thus the potential for human error. By electronically verifying the position and identity of slabs these can be automatically updated without any human involvement.

In order that the invention may be well understood it will now be described with reference to the accompanying diagrammatic drawings in which:

Figure 1 is a schematic drawing of a steelworks; and

Figure 2 is a schematic drawing of the radio signalling means.

In the drawing a casting mould C is arranged to cast a batch of steel slabs which will require processing at a subsequent processing station B. (The processing steps

may be rolling as in a rolling mill, scarfing, cutting, heat treatment or the like). Because of the way in which work is handled at a steel mill it is necessary to store batches of slabs 5 between operations and this is done in one or more storage areas which are divided up into parking lots P1, P2, P3, P4. According to the invention one or more transponders T are set into the ground adjacent one edge of each parking lot. Each transponder provides an individual transmission signal, i.e. a code. Transponders are also present at each station, e.g. inset into the floor adjacent a rolling mill.

The batches of slabs are moved about the steelworks on a suitable vehicle V. This is provided with a radio frequency reader R arranged to communicate with the transponders via an antenna A. The cab of the vehicle also includes a computer interface which is in communication, e.g. by radio signals with a CPU associated with the caster and rolling mill computers.

In operation, a radio signal is transmitted from the CPU to a computer interface of a vehicle V setting out the code number of the location at which slabs are to be picked up and the corresponding slab identities and the code number of the destination station. For example a batch may need to be moved from a storage area to a processing station. The vehicle then travels to the storage area and on arrival the radio frequency reader sends a radio signal via the antenna A to verify the code of the respective transponder. If the transponder code corresponds to the assigned code the operator lifts the slabs and transports them to the destination station. He checks the code of that before depositing the load. He can check his route using the transponders along the roadways and can identify his location in transit to a central control on request.

The invention is not limited to the embodiment shown. The signal transmission need not be by radio waves but could by optical, laser inductive coupling, or the like.

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CLAIMS

1. A manufacturing installation comprising a plurality of processing stations each to perform a processing step on a batch of articles to be manufactured, the installation also having storage stations made up of storage regions, wherein each processing station has an identifying code means assigned thereto, and each region has identifying code means assigned thereto; and the installation includes a vehicle to move the batches between stations and regions which vehicle is provided with means for reading the code means whereby each batch is placed in or removed from a location the code of which is the same as the intended code.

2. An installation according to Claim 1, wherein the code reading means associated with the vehicle is arranged to transmit a radio signal to read the code means.

3. An installation according to Claim 2, wherein the code reading means is arranged to activate a transponder associated with the code means.

4. An installation according to Claim 3, wherein the code means are set below the ground level of the processing station or storage region.

5. An installation according to any preceding Claim, wherein the vehicle is a wheeled vehicle.

6. An installation according to Claim 5, wherein the wheeled vehicle is provided with rubber tyres.

7. A method of subjecting a batch of articles to a succession of processing steps at different processing stations in a manufacturing installation, the batches being moved by a vehicle between processing stations and to and from storage stations between processing, the method comprising:

- assigning identifying code means to each processing station and to each storage region at a storage station;

- providing code reading means on the vehicle, identifying each batch to be moved by the code of its location and that of its destination, and causing the vehicle to confirm the present location code and the before removing the batch and confirming the code of the destination station before depositing the transported batch.

8. A method according to Claim 7, wherein the reading means is arranged to communicate with the code means by radio waves.

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Patents Act 1977
Examiner's report to the Comptroller under Section 17
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Search Examiner
M J Billing

Date of completion of Search
11 August 1994

Databases (see below)
(i) UK Patent Office collections of GB, EP, WO and US patent specifications.

(ii)

Documents considered relevant following a search in respect of Claims :-
1-8

Categories of documents

X: Document indicating lack of novelty or of inventive step.

Y: Document indicating lack of inventive step if combined with one or more other documents of the same category.

A: Document indicating technological background and/or state of the art.

P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

&: Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages		Relevant to claim(s)
X	GB 2143395 A	(GENERAL ELECTRIC) eg see Figures 1-3; page 1 line 95 - page 2 line 30	1,5,6,7 at least
X	GB 1278929	(CLARK) eg see Figures 1, 2, 5 page 2 line 60 - 118	1,5,7 at least
X	GB 1070176	(CONCO) eg see Figures 1, 3-6; page 3 line 11 - page 4 line 98	1,5,7 at least
X	US 4642017	(AMCA) eg see column 10 line 38 - column 11 line 39, column 16 line 54 - column 17 line 16	1,2,3,4, 7,8 at least

Databases: The UK Patent Office database comprises classified collections of GB, EP, WO and US patent specifications as outlined periodically in the Official Journal (Patents). The on-line databases considered for search are also listed periodically in the Official Journal (Patents).

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